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MOTIVATION OF R&D ENTREPRENEURS: DETERMINANTS OF COMPANY SUCCESS (I) (REVISED)

Herbert A. Wainer and Irwin M. Rubin

December, 1967 #303-67*

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The research presented in this paper was supported in part by grants from the M.I.T. Center for Space Research and by the National Aeronautics and Space Administration (NsG-235 and NsG-496). However the findings and views reported are those of the authors and do not necessarily reflect those of the supporting agencies. This work was done in part at the M.I.T. Computation Center.

*This working paper supersedes working paper #234-67 by the same title.

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Abstract

Fifty one technical entrepreneurs were studied focusing upon the relationships between their motivation and company performance. More specifically, the relationships between the entrepreneurs' need for achievement, need for power, and need for affiliation were related to the performance of the 51 small companies they founded and operated. The results indicate that high need for achievement and moderate need for power are associated with high company performance. The effect of need for power and need for affiliation on performance seems to be derived through their influence on leadership styles.

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Motivation of R&D Entrepreneurs: Determinants of Company Success (1)

Herbert A. Wainer, Irwin M. Rubin

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In an attempt to associate need for achievement (n-ach) and economic development, McClelland (1961) looks to the entrepreneur as the one who translates n-ach into economic development. The entrepreneur in McClelland's scheme (1961, p.205) is, "the man who organizes the firm (the business unit) and/or increases its productive capacity."

The present authors aim was to test McClelland's macro theory of economic growth at the micro level of organizational performance. Our principal interest in considering McClelland's work is in his discussions of who entrepreneurs are and his suggestions as to differences in behavior that might be expected due to differences in need patterns. McClelland's underlying assumption is that entrepreneurs have a high n-ach and that in business situations their high n-ach will lead them to behave in certain ways and have certain tendencies. These are discussed briefly here.

A crucial element in almost any business situation is decision-making under uncertainty. This means that almost every decision that has to be made has associated with it a degree of risk. The entrepreneur, who supposedly is driven by his need for achievement, will tend to undertake alternative courses of action which have moderate risk characteristics rather than those that are at either end of the risk continuum. The rationale for such behavior lies in the satisfaction expected from the different risk-associated decisions. In the situation in which there is

complete certainty as to outcomes, the individual making the decision derives little satisfaction of his need for achievement because of the predetermined nature of the solution. In the pure chance situation the individual making the decision again derives little satisfaction of his need for achievement because of the lack of effect of skill on the outcome. The outcomes of decisions with moderate risk are dependent on a mixture of skill and chance and thus are most apt to satisfy the entrepreneur.

Entrepreneurs, according to McClelland, tend to work hard and to do things in an innovative rather than traditional manner. However, they do not work hard at everything. They work harder when there is a challenge and when the completion of work to be done requires ingenuity rather than standard procedures. Entrepreneurs thrive on situations in which they can get a sense of personal achievement through taking responsibility for success and failure. They require concrete feedback in the form, for example, of number of pieces produced or profit per item as measures of how well or how poorly they are doing. Entrepreneurs are future oriented in that they tend to think ahead more in their decision making.

Based on McClelland's discussion, the present authors raised the proposition that the degree to which an entrepreneur is motivated by n-ach directly influences his skill as an entrepreneur and thus his enterprise's performance. The major hypothesis to be tested, then, concerns the relationship between an entrepreneur's level of n-ach and

his company's performance. More specifically, given that an individual becomes an entrepreneur (thereby placing himself in a situation capable of satisfying high n-ach individuals), the performance of his company is directly related to his level of n-ach.

Schrage, (1965), in part interested in testing the relationship between the entrepreneur's n-ach and company performance, reported the following findings; companies run by entrepreneurs who have a high n-ach tend to have either high profits or losses ($\pm$ 3% of sales), while those run by low n-ach entrepreneurs tend to have low profits or losses ($\leq$3% of sales). Reanalysis by the present authors of his data, particularly the T.A.T. scores used as his measure of n-ach, shed considerable doubt on the validity of his findings. Primarily, the source of doubt was a discrepancy between the scores Schrage used for n-ach and those subsequently derived by rescoring the same protocols by the Motivation Research Group at Harvard University. (Intercoder reliability for Motivation Research Group vs. n-ach scores used by Schrage was 0.60 rank order correlation.) A further rescoring by a different individual in the same Harvard group indicated that the Motivation Research Group scores were the more valid (intercoder reliability for the Motivation Research Group on the Schrage protocols was .94 rank-order correlation). Schrage's findings, in other words, are based upon n-ach scores of questionable reliability which led the authors to seriously question the validity of his findings. The fact that his results also departed markedly from established theory further substantiates this concern.

In additon to the relationship between n-ach and company performance, the authors were interested in the relationships among three needs, n-ach, need for power (n-pow), and the need for affiliation (n-aff), particularly as such relationships or joint products might affect company performance. N-pow is defined by Atkinson (1958, p.105) as, "that disposition, directing behavior toward satisfactions contingent upon the control of the means of influencing another person. In the phenomenal sphere of the power-motivated individual he considers himself the 'gate keeper' to certain decision-making of others. The means of control can be anything at all that can be used to manipulate another person."

N-aff is concerned with the establishment, maintainance, or restoration of positive affective relationships with other people. These relationships are most adequately described by the word friendship. Statements of liking or desire to be liked, accepted, or forgiven are manifestations of this motive. (Atkinson, 1958) The inquiry from this aspect was stimulated by McClelland's discussion of the joint product of n-pow and n-aff in relation to dictatorship. (1961) He found that n-pow was not related to economic growth but was related to style of leadership. More specifically, the combination of a high n-pow and a low n-aff was associated with the tendency of a country to resort to totalitarian methods as a style of leadership. The implication is that high n-pow leads to authoritarian control in which there is little concern for people in general unless the n-pow is checked by a high n-aff as is the case in the United States.

The present authors propose that n-ach has different behaviorial manifestations than either n-pow or n-aff in terms of the individual's relationships with people. N-pow and n-aff are interpersonally oriented needs. Implicit in their definitions is the existence of other human beings with whom the n-pow or n-aff motivated individual can influence and control or be friends. N-ach, on the other hand, seems to be more of an internalized need than either n-pow or n-aff. The n-ach motivated individual may need other people to help him to satisfy his n-ach but the nature of his relationship with them, or more appropriately his effectiveness with them will be determined by needs other than n-ach. The authors are suggesting that n-ach is a primary consideration determining non-interpersonally related behavior that leads to high company performance (i.e. decision making characteristics, commitment to work, recognition of the need for plans leading to tangible outcomes such as profits or sales volume, etc.) N-pow and n-aff are primary considerations determining interpersonal behavior that affects company performance (i.e. being concerned about people, being authoritarian, being paternal, etc.). N-pow and n-aff, then, can be looked upon as having strong implications as determinants of management style.

Numerous other attempts have been made to identify those personality traits which differentiate leaders from non-leaders or effective leaders from ineffective leaders. These studies have, in general, failed to find any consistent pattern of differentiating traits. In a broad sense, the present research is analogous to these prior efforts in that it seeks to explain company performance on the basis of certain personality

characteristics of the president. Several steps were taken, however, to anticipate two potential problem areas that Gibb suggests are possible reasons for the inconsistent results of prior studies (Gibb, 1954): (1) Personality description and measurement themselves are not yet adequate. Reliable means of measuring basic personality dimensions are still needed. It may be that in leadership researches the really significant aspects of personality have not yet been investigated. (2) The groups studied have usually been markedly different from one another and this may have had the effect of concealing a relation between personality and the exercise of leadership within a more homogeneous set of groups or family of situations.

The major personality variable of interest in the present study was need for achievement. There seemed little doubt, in view of the existing body of prior research, that McClelland's version of the Thematic Apperception Test (T.A.T.) provided a reliable means of measuring the personality trait of primary interest (McClelland, 1961; Atkinson, 1958).

With respect to the second problem area, a very homogeneous set of groups or family of situations have been examined. In effect, this means that the potential influence of the "situation" has been mitigated thereby increasing the probability of finding a relationship between the leader's personality and company performance. Clearly, if one sought to explain variations in company performance on the basis of the president's need for achievement, the situations studied would have to be such that: (1) the need (if it should exist) could manifest itself in concrete behavioral terms and, (2) this behavior would be

capsble of making a real difference in terms of company performance.

It would be surprising, indeed, to find a relationship between the profits of companies like General Motors and their presidents' need for achievement.

For these reasons, the focus in this study was upon the new, small, technically-based enterprise. The entrepreneur-president of such a company has placed himself in a situation where his need for achievement, to the extent that it exists, can be readily translated into concrete behavior. He starts the company, hires people and motivates them, sells, plans, takes risks, and so on. It is his personality and motivation that molds the company in its every aspect. Furthermore, in such situations, the entrepreneurs' efforts and decisions are likely to be very important in determining the initial success of the venture.

Methodology

Fifty-one small technically-based companies in the Boston area were selected for study. All companies were at least four but less than ten years old at the time of the study. All were "spin-offs" from one of the M.I.T. research laboratories or industrial laboratories around the Boston area. They ranged in business activities from service, such as computer software development, to manufacturing, such as special purpose computers and welded modules. Company and entrepreneurial-personality information were gathered from the entrepreneur-president. The typical entrepreneur, based on the central tendencies for the total sample of entrepreneurs, was approximately 36 years of age when he started his new enterprise, was educated to the Master's degree level, and had considerable experience at a technically advanced research laboratory prior to starting his new enterprise. Among the information gathered were company yearly sales figures and the McClelland version of the Thematic Apperception Test (T.A.T.) for each entrepreneur. The yearly sales figures were used as the basis for determining growth rate which is defined in detail below. The measure of growth rate was used in this paper as the index of performance. The T.A.T.'s were scored for n-ach, n-pow, and n-aff by the Motivation Research Group at Harvard University in Cambridge, Massachusetts. The resulting scores were the basis for the analysis of the strength of various needs in relation to performance.(2)

Growth Rate is defined as follows: annual increase in the logarithm

of sales volume between the second and most recent year reported. The easiest way to understand this measure is to consider an example. Company A is seven years old. Its second year sales were $100,000 and its last year (seventh) sales were $950,000. These two sales values are plotted on semi-log paper. The Growth Rate is indicated by the percent rate of change from year to year. This is, of course, constant over the seven years. The Growth Rate in this case would be approximately .56. Table 1 summarizes the general characteristics of the four variables with which we are concerned in this paper.

Our analysis strategy will, in all cases, be a comparison of high, moderate, and low groups. Equality of sample size, within the limits of tied observations, was the criterion utilized in making these groupings. Standard correlational techniques were feasible in many cases and, where appropriate, coefficients will be presented in footnotes. However, it is the authors' feeling that such techniques often mask non-linear trends in relationships and it is for this reason that the Mann-Whitney U. Test (Siegel, 1956), one of the most powerful of the non-parametric statistical tests, was used. Furthermore, correlation techniques focus on differences between two variables based on individual differences from case to case. On the other hand, the Mann-Whitney U. test, a difference in medians test, analyzes differences between characteristics of groups of data. It is the authors' feeling that T.A.T. scoring procedures are not yet precise enough to enable researchers to utilize individual differences as the basis for comparison.

Insert Table 1

Table 1

Means, Medians, and Ranges of Variables Measured

VARIABLE	MEAN	MEDIAN	RANGE
N-ACH	5.9	5.0	-5 TO 18
N-POW	9.7	9.5	0 TO 19
N-AFF	3.5	3.0	0 TO 16
GROWTH RATE	0.40	0.375	0.0 TO 2.10

Results

The aim in this section is to present the results of the analyses concerning the relationship between the three needs; n-ach, n-pow, and n-aff and the relationship between the needs and company performance. In addition, some exploratory results will be presented which focus on the question: Is there a pattern or combination of needs which are related to high company performance? In other words, while one set of analyses will focus on the direct relationship between performance and varying degrees of strength in a single need, a secondary focus will be that of exploring effects on company performance determined by several needs taken together.

Relationship between the three needs

The data in Table 2 suggest that, within this sample, n-ach, n-pow, and n-aff are not completely independent.[3] N-ach appears to be positively related to n-pow and negatively related to n-aff while n-pow is negatively related to n-aff. It is important to note, however, that in all cases the relationship is non-linear. In the case of n-ach vs. n-pow, for example, only the low n-ach group has a significantly different n-pow score. No differences in n-pow are observed when a comparison is made of the high vs. mod. n-ach groups. A similar phenomenon is present in each relationship. In other words, the correlation coefficients reported in footnote 3 are heavily influenced by a small subset of the total distribution of need scores.

With these qualifications in mind, it is concluded, that the three needs are moderately related. Where necessary, when the relationship of each need to company performance, is examined, an attempt will be

made to take into account this lack of independence.

Insert Table 2

Need strength vs. company performance

The major hypothesis in this study predicts a direct and positive relationship between an entrepreneur's n-ach and the performance of his company. No directional hypotheses were specified concerning the relationships between, n-pow, n-aff, and company performance.(4)

Referring to Table 3, it can be seen that, within the range of moderate to high n-ach, a very marked positive relationship exists between n-ach and company performance. The growth rate of those companies led by entrepreneurs with a high n-ach was almost 250% higher (0.73 vs. 0.21) than those companies led by entrepreneurs with a moderate n-ach. Here again, however, the relationship is not purely linear with the low n-ach group having a mean performance score slightly higher than the moderate n-ach group but still significantly lower than high n-ach group. Possible reasons for this will be discussed in the concluding section.

N-pow, as can be seen from Table 3, is completely unrelated to company performance. N-aff, on the other hand, exhibits a mildly negative, non-linear, relationship to company performance. This relationship between n-aff and performance, in conjunction with the relationships discussed earlier between n-ach vs. n-aff and n-ach vs. performance necessitated further analyses. The data were examined to see if the observed relationship between n-ach and n-aff was influencing the relationship found between n-ach and performance. No such contamination

Table 2

Relationship Between the Three Needs

N-ACH, N-POW, N-AFF

	N-ACH		
	(≥ 9) HI n=14	(4≥ x≤8) MOD n=19	(≤3) LO n=18
N-POW	11.3(a)	11.1(b)	6.8(c)
N-AFF	2.0(d)	3.9(e)	4.4(f)

Mann-Whitney U Test Results: (two-tail)

a vs. b = p<.60
a vs. c = p<.003
b vs. c = p<.007

d vs. e = p<.13
d vs. f = p<.02
e vs. f = p<.45

	N-POW		
	(≥ 13) HI n=15	(8≥ x≤12) MOD n=19	(≤7) LO n=17
N-AFF	2.8(a)	3.0(b)	4.7(c)

Mann-Whitney U Test Results (two-tail)

a vs. b = p<.60
a vs. c = p<.11
b vs. c = p<.09

was found. Of those who were classified in the low n-aff group (n = 13), for example, only six fell into the high n-ach group. N-ach, in other words, directly effects company performance, independent of its relationship to n-aff.

Insert Table 3

The results of this section are summarized graphically in Figure 1. What the authors have done here is to plot, for each of the needs, the percentage of companies within each subgroup (high, moderate, low) whose performance is above that of the median for the total sample of entrepreneurs. Seventy-nine percent of those companies, for example, led by entrepreneurs whose n-ach was high, had a growth rate which was above the median for the total sample of entrepreneurs.

Insert Figure 1

Joint products of needs vs. performance

The previous section focused on variations in company performance resulting from each of the three needs (n-ach, n-pow, and n-aff) taken singularly. The aim in this section is to explore the question of whether or not any pattern of need strengths appears to be associated with high company performance. In examining the data, it was noticed that, in addition to the very wide differences in company performance noted between high, moderate, and low n-ach groups, there existed substantial variations in company performance within each of these three groupings. In other words, although the high n-ach group exhibited very high

Table 3

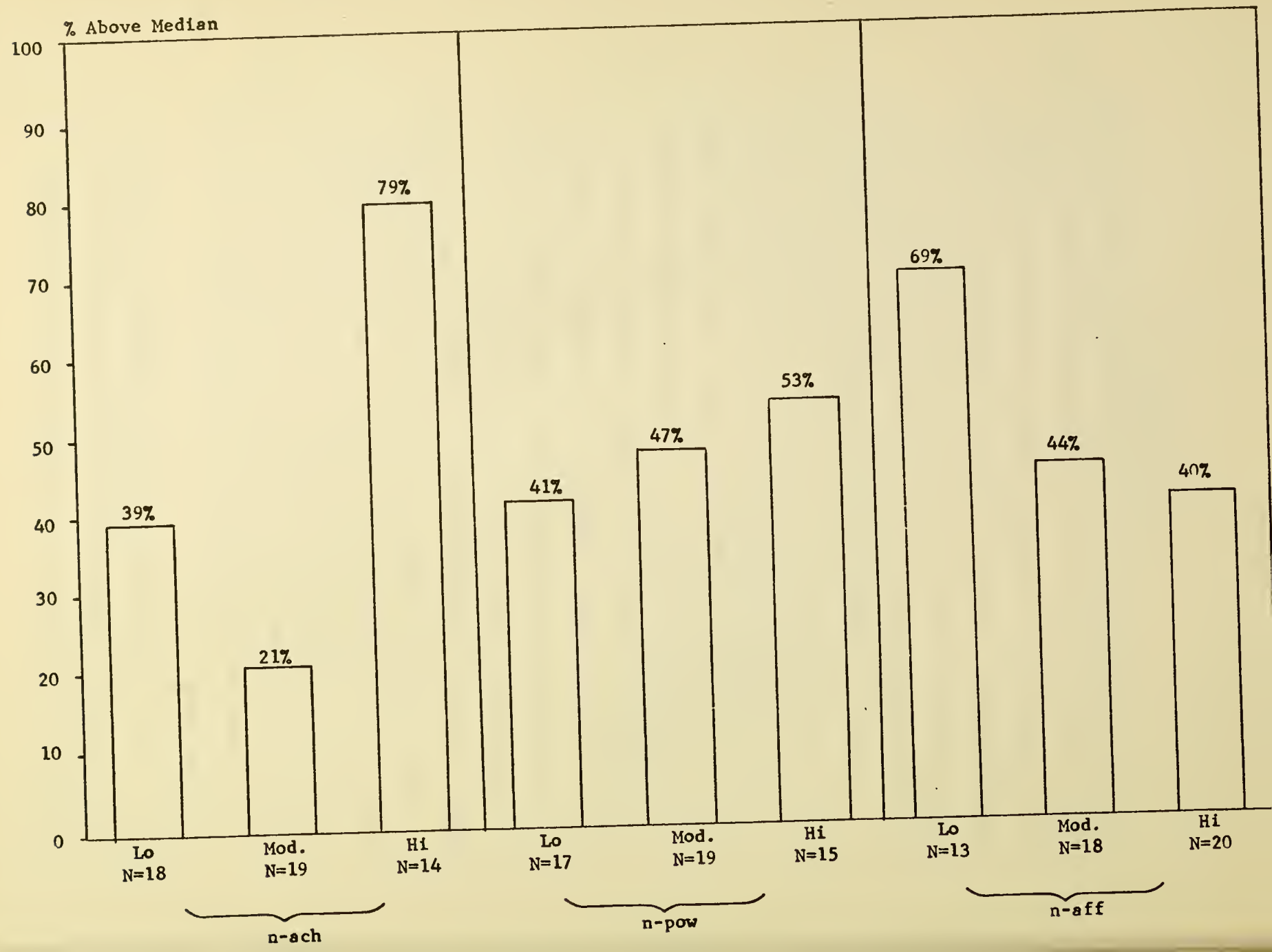
Relationship Between N-ach, N-pow and N-aff and Growth Rate

Need	Code for MWU Results	Strength	Mean Growth Rate
N-ACH	A	HI (≥ 9) N=14	.73
	B	MOD ($4 \geq X \leq 8$) N=19	.21
	C	LOW (≤ 3) N=18	.36
N-POW	A	HI (≥ 13) N=15	.38
	B	MOD ($8 \geq X \leq 12$) N=19	.47
	C	LOW (≤ 7) N=17	.36
N-AFF	A	HI (≥ 4) N=20	.33
	B	MOD ($2 \geq X \leq 3$) N=18	.30
	C	LOW (≤ 1) N=13	.67

Results of Mann-Whitney U Tests:

N-ach vs. Growth Rate: (one-tail)	A vs. B,	$p < .0001$
	A vs. C,	$p < .006$
	B vs. C,	$p < .08$
N-pow vs. Growth Rate: (two-tail)	A vs. B,	$p < .80$
	A vs. C,	$p < .90$
	B vs. C,	$p < .80$
N-aff vs. Growth Rate: (two-tail)	A vs. B,	$p < .81$
	A vs. C,	$p < .16$
	B vs. C,	$p < .10$

Percentage of Companies Above Median Growth Rate for Total Sample



performance in comparison with the moderate and low n-ach groups, the range of performance scores within the high n-ach group was from 0.14 to 2.10. Similar within group ranges were observed in the other two n-ach groupings.

An attempt was made, therefore, to determine whether or not these within group variations could be attributed to variations in the strengths of the other two needs being investigated, n-pow and n-aff. Within each of the three n-ach groupings (high, moderate, and low), the authors have further split the samples into high vs. low performers (at the median performance score within each n-ach group) and compared levels of n-pow and n-aff within each of these new subgroups.

The following patterns emerge from the data summarized in Table 4. Within the low n-ach group, variations in performance are uneffected by variations in n-pow or n-aff. Within the moderate n-ach group, n-pow is identical for high vs. low performers while high performers within this group have a significantly higher n-aff. Finally, within the high n-ach group, n-aff is identical for high vs. low performers while high performers within this group have a significantly lower n-pow.

In summary, the highest performing companies in this sample were led by entrepreneurs who exhibited a high n-ach and a moderate n-pow. Those entrepreneurs who had a high n-ach coupled with a high n-pow performed less well than their high n-ach counterparts who exhibited only a moderate level of n-pow.(5) Within the moderate n-ach group, higher performing companies were led by entrepreneurs who had a high n-aff. Possible interpretations for these patterns follow in the next section.

Insert Table 4

Table 4

Relationship Between Performance and N-pow, N-aff

within High, Moderate, and Low N-ach Groups

	High N-ach (≥ 9.0)		Mod. N-ach ($4 \leq X \leq 8$)		Low N-ach (≤ 3.0)	
	Low Perf. ($\leq .59$) N=7	High Perf. ($> .59$) N=7	Low Perf. ($\leq .13$) N=9	High Perf. ($\geq .21$) N=10	Low Perf. ($\leq .26$) N=9	High Perf. ($> .26$) N=9
N-pow	13.1(a)	9.4(b)	11.0(c)	11.0(d)	7.0(e)	6.7(f)
N-aff	2.0(g)	2.0(h)	2.2(i)	5.5(j)	4.9(k)	4.0(l)

Mann-Whitney U Test (Two Tail)

A vs. B, $p < .08$
C vs. D, $p < .40$
E vs. F, $p < .50$
G vs. H, $p < .50$
I vs. J, $p < .02$
K vs. l, $p < .25$

Discussion

The major hypothesis tested in this study predicted a positive-relationship between an entrepreneur's level of n-ach and his company's performance. Our findings strongly support the conclusion that high n-ach is associated with high company performance but the relationship between n-ach and performance is not linear accross the entire range of n-ach scores. The relationship is markedly linear for the entrepreneurs whose n-ach is moderate to high. However, those entrepreneurs who scored low in n-ach were not significantly lower performers than those whose n-ach was moderate.

In an attempt to explain this non-linesrity it seems reasonable to assume that other needs or factors are influencing the entrepreneurial behavior of individuals who are not moderate to high in their level of n-ach. It is extremely likely that some threshold level of n-ach is necessary before one could assume that the strength of the need is significantly affecting the individual's behavior. In addition, it is obvious that we do not see n-ach as being the only (or for that matter the most important) factor which influences company performance. We are arguing, however, that where the need exists in sufficient strength to influence significantly entrepreneurial behavior, company performance will in general improve.

A secondary aim in this study was to explore the question of whether a certain pattern or combination of needs was most often associated with high performance. In the introduction to this paper, it was suggested that n-pow and n-aff were needs whose behavioral

manifestations were interpersonal in character. Satisfaction of these two needs, by definition, involves relationships with other people. N-ach, on the other hand, is much more individualistic in character. Satisfaction of one's n-ach, although often involving contact with other people, has behavioral manifestations which are qualitatively different in nature than either n-pow or n-aff.

The results of this study suggest that the combination of a high n-ach and a moderate n-pow characterizes the highest performing companies in the sample. In other words, a high (as opposed to moderate) level of n-pow appeared to counter balance to some extent the positive benefits of a high level of n-ach.

One possible explanation for this finding lies in the relationship between n-pow and various styles of leadership. The lower an individual's n-pow, the more permissive or laissez-faire his style of leadership while the higher his n-pow, the more autocratic or authoritarian his style of leadership. The middle of the n-pow spectrum represents a mixed influence of the two extreme styles which is best described by democratic.(6) Prior research (Lippitt and White, 1958) has suggested that in certain situations the most effective leadership style is democratic and that performance of groups controlled in this manner is better than that of groups controlled by either of the other two styles.

Somewhat more difficult to explain is the finding concerning the positive differential effect on company performance, within the moderate n-ach group, of a high vs. low level of n-aff. It may be that for those individuals who have only a moderate level of n-ach, a high level of n-aff enables them to form close interpersonal relationships

with their work collegues. In this way, the moderate n-ach individual may be able to acquire the assistance he needs from his colleagues, some of whom may well have a higher level of n-ach than he has himself to make better business decisions.

Our interpretations in this area of need combinations must be viewed, at this point, as speculative and suggestive of further research. Analysis of the results of this study indicate that more complex relationships do have to be examined if a realistic view of performance determined by personality is to be gained.

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Footnotes

(1) The research presented in this paper was supported in part by grants from the M.I.T. Center for Space Research and by the National Aeronautics and Space Administration (NsG-235 and NsG-496). However the findings and views reported are those of the authors and do not necessarily reflect those of the supporting agencies. This work was done in part at the M.I.T. Computation Center.

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(2) Average intercoder reliabilities of scores from the Motivation Research Group are in the high 0.80 range.

(3) The following are the Kendall Tau correlations between three needs (two tail test).

n-ach vs. n-pow; $T = 0.370$ $p < .01$, $N=51$

n-ach vs. n-aff; $T = -0.259$ $p < .01$, $N=51$

n-aff vs. n-pow; $T = -0.233$ $p < .05$, $N=51$

(4) The following are the Kendall Tau correlations between the three needs and company performance (Growth Rate):

n-ach vs. performance; $T = 0.15$, $p < .08$, $N=51$ (one-tail)

n-pow vs. performance; $T = 0.05$, $p < .64$, $N=51$

n-aff vs. performance; $T = -0.11$, $p < .28$, $N=51$

(5) When we use the phrases "moderate n-pow" or "high n-pow" we are using as our reference point the distribution of scores observed in this study sample. Our specification, for example, of <u>high</u> n-pow as being ≥ 13.0 was made <u>prior</u> to the analyses under discussion in this

section. Consequently, classification of a mean n-pow of 13.1 as "high" and a mean n-pow of 9.4 as moderate is consistent with our a priori definitions.

(6) The authors have assumed of course that high n-pow leaders are more likely to exercise an autocratic style of leadership and low n-pow leaders a laissez-faire style.

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